

ABSTRACT

The present invention provides microfluidic devices and methods for using the same. In particular, microfluidic devices of the present invention are useful in conducting a variety of assays and high throughput screening. Microfluidic devices of the 5 present invention include elastomeric components and solid substrate component for attaching ligand(s) on its surface. The elastomeric layer comprises (a) a plurality of first flow channels; (b) a plurality of second flow channels each intersecting and crossing each of said first flow channels thereby providing a plurality of intersecting areas formed at intersections between said first flow channels and said second flow channels, wherein 10 said plurality of first flow channels and said plurality of second flow channels are adapted to allow the flow of a solution therethrough, and wherein said solid substrate surface is in fluid communication with at least said intersecting areas of said plurality of first flow channels and said plurality of second flow channels, and wherein said plurality of first flow channels and/or said plurality of second flow channels are capable of forming a 15 plurality of looped flow channels; (c) a plurality of control channels; (d) a plurality of first control valves each operatively disposed with respect to each of said first flow channel to regulate flow of the solution through said first flow channels, wherein each of said first control valves comprises a first control channel and an elastomeric segment that is deflectable into or retractable from said first flow channel upon which said first control 20 valve operates in response to an actuation force applied to said first control channel, the elastomeric segment when positioned in said first flow channel restricting solution flow therethrough; (e) a plurality of second control valves each operatively disposed with respect to each of said second flow channel to regulate flow of the solution through said second flow channels, wherein each of said second control valves comprises a second 25 control channel and an elastomeric segment that is deflectable into or retractable from said second flow channel upon which said second control valve operates in response to an actuation force applied to said second control channel, the elastomeric segment when positioned in said second flow channel restricting solution flow therethrough; (f) a plurality of loop forming control valves each operatively disposed with respect to each of 30 said first and/or said second flow channels to form said plurality of looped flow channels, wherein each of said loop forming control valves comprises a loop forming control channel and an elastomeric segment that is deflectable into or retractable from said first and/or said second flow channels upon which said loop forming control valve operates in

- response to an actuation force applied to said loop forming control channel, the elastomeric segment when positioned in said first and/or said second flow channels restricting solution flow therethrough thereby forming said looped flow channel; and (g) a plurality of recirculating pumps, and wherein each recirculating pump is operatively
- 5 disposed with respect to one of said looped flow channels such that circulation of solution through each of said looped flow channels can be regulated by one of said recirculating pumps.